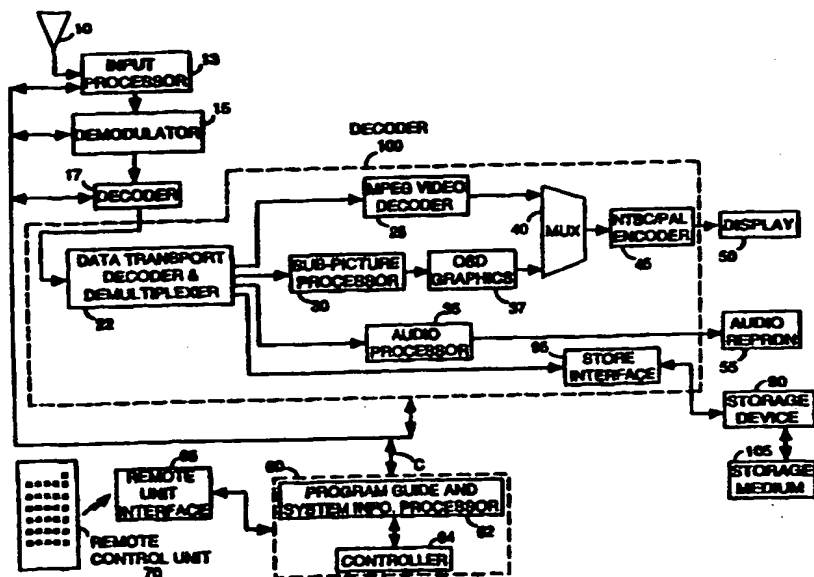




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(54) Title: A SYSTEM FOR FORMING AND PROCESSING PROGRAM MAP INFORMATION SUITABLE FOR TERRESTRIAL, CABLE OR SATELLITE BROADCAST



## (57) Abstract

Channel map information includes program map table information in packetized program information used in video processing and storage medium formats. In a digital video system for decoding (100) an MPEG compatible datastream containing MPEG compatible program map table information, channel map information is identified and assembled (60, 22). The channel map information identifies individual packetized datastreams that constitute a broadcast program. The channel map information associates a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted in the broadcast channel. The channel map information replicates information conveyed in the MPEG compatible program map table information.

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5       A System for Forming and Processing Program Map  
Information Suitable for Terrestrial, Cable or Satellite  
Broadcast

10               This invention is related to the formation of Program  
Guides, system information and program specific information for  
MPEG compatible processing.

15               In video broadcast and processing applications, digital  
video data is typically encoded to conform to the requirements of  
a known standard. One such widely adopted standard is the  
MPEG2 (Moving Pictures Expert Group) image encoding standard,  
hereinafter referred to as the "MPEG standard". The MPEG  
20       standard is comprised of a system encoding section (ISO/IEC  
13818-1, 10th June 1994) and a video encoding section (ISO/IEC  
13818-2, 20th January 1995). Data encoded to the MPEG standard  
is in the form of a packetized datastream which typically includes  
the data content of many program channels (e.g. content  
25       corresponding to cable television channels 1-125). Further, several  
digital services and channels may occupy the frequency spectrum  
previously occupied by a single analog channel. A 6 MHz  
bandwidth previously allocated to an analog NTSC compatible  
broadcast channel may now be split into a number of digital sub-  
channels offering a variety of services. For example, the broadcast  
30       spectrum for RF channel 13 may be allocated to sub-channels  
including a main program channel, a financial service channel  
offering stock quotes, a sports news service channel and a  
shopping and interactive channel. In addition, both the quantity  
of sub-channels transmitted and the individual sub-channel  
35       bandwidth may be changed dynamically to accommodate changing  
broadcast programming requirements.

40               In such a digital video system the proliferation in the  
quantity of services being broadcast and the increased variety of  
their content, as well as the ability of a broadcaster to dynamically  
vary the number and allocated bandwidth of these channels poses  
a number of problems. Specifically, the increase in the quantity of

5 broadcast channels may increase the difficulty of tuning and  
lengthen the time required to acquire a selected program channel.  
Further, as the quantity of channels increases so does the quantity  
of ancillary program specific information required in decoding the  
transmitted program data. The ancillary program specific  
10 information includes data used in identifying and assembling  
packets comprising selected programs and also includes program  
guide and text information associated with the transmitted  
program data. The increased quantity and variety of ancillary  
information transmitted places an additional burden on available  
15 transmission bandwidth and receiver decoding and storage  
resources.

In addition, channel numbering in such a digital video  
system may present a problem. This is because a broadcaster may  
not want to lose an original analog NTSC broadcast channel  
20 number even though the broadcaster is transmitting several  
program channels in the frequency spectrum previously occupied  
by the single analog program channel. The broadcaster may have  
a significant investment in the channel number as a brand  
identity e.g. Fox 5<sup>TM</sup>, Channel 13<sup>TM</sup>. These problems and derivative  
25 problems are addressed by a system according to the present  
invention.

In a digital video system for decoding an MPEG  
compatible datastream containing MPEG compatible program map  
30 table information, channel map information is identified and  
assembled. The channel map information identifies individual  
packetized datastreams that constitute a broadcast program. The  
channel map information associates a broadcast channel with  
packet identifiers used to identify individual packetized  
35 datastreams that constitute a program transmitted in the  
broadcast channel. The channel map information replicates  
information conveyed in the MPEG compatible program map table  
information.

5

*Brief Description of the Drawings*

In the drawing:

10        Figure 1 is a block diagram of digital video receiving apparatus for demodulating and decoding broadcast signals, according to the principles of the invention.

15        Figure 2 shows a Master Guide Table (MGT) format for use in conveying program specific information, according to the invention.

20        ~~Figure 3 shows a Channel Information Table (CIT) format for use in conveying program specific information incorporating dual program channel identification numbers, according to the invention.~~

25        Figure 4 shows a Service Location Descriptor (SLD) format for use in conveying program specific information incorporating program map information, according to the invention.

30        Figure 5 shows a program specific information text format for use in conveying program related text information, according to the invention.

      Figure 6 shows a scheme for assigning a text message identifier as used in the text format of Figure 5.

35        Figure 7 shows a multiple compressed text string format for use in conveying program related text information, according to the invention.

40        Figures 8 and 9 show exemplary indicator definitions for compression and coding indicators within the multiple compressed text string format of Figure 7.

5           Figure 10 shows a method for generating program specific information according to the invention.

10           Figure 1 is a block diagram of a digital video receiving system for demodulating and decoding broadcast signals, according to the principles of the invention. Although the disclosed system is described in the context of a system for receiving video signals incorporating program specific information including program guide data in MPEG compatible format, it is exemplary only. The program specific information may be of a variety of  
15           types. For example, it may comply with Program Specific Information (PSI) requirements specified in section 2.4.4 of the MPEG systems standard or it may comply with the high definition television (HDTV) signal standard *Digital Television Standard for HDTV Transmission* of April 12 1995, prepared by the United  
20           States Advanced Television Systems Committee (ATSC) or other ATSC standards. Alternatively, it may be formed in accordance with proprietary or custom requirements of a particular system.

25           The principles of the invention may be applied to terrestrial, cable, satellite, Internet or computer network broadcast systems in which the coding type or modulation format may be varied. Such systems may include, for example, non-MPEG compatible systems, involving other types of encoded datastreams and other methods of conveying program specific information.  
30           Further, although the disclosed system is described as processing broadcast programs, this is exemplary only. The term 'program' is used to represent any form of packetized data such as audio data, telephone messages, computer programs, Internet data or other communications, for example.

35           In overview, in the video receiver system of Figure 1, a broadcast carrier modulated with signals carrying audio, video and associated data representing broadcast program content is received by antenna 10 and processed by unit 13. The resultant digital output signal is demodulated by demodulator 15. The  
40           demodulated output from unit 15 is trellis decoded, mapped into byte length data segments, deinterleaved and Reed-Solomon error

5 corrected by decoder 17. The corrected output data from unit 17  
is in the form of an MPEG compatible transport datastream  
containing program representative multiplexed audio, video and  
data components. The transport stream from unit 17 is  
demultiplexed into audio, video and data components by unit 22  
10 which are further processed by the other elements of decoder  
system 100. In one mode, decoder 100 provides MPEG decoded  
data for display and audio reproduction on units 50 and 55  
respectively. In another mode, the transport stream from unit 17  
is processed by decoder 100 to provide an MPEG compatible  
15 datastream for storage on storage medium 105 via storage device  
90.

A user selects for viewing either a TV channel or an  
on-screen menu, such as a program guide, by using a remote  
control unit 70. Processor 60 uses the selection information  
20 provided from remote control unit 70 via interface 65 to  
appropriately configure the elements of Figure 1 to receive a  
desired program channel for viewing. Processor 60 comprises  
processor 62 and controller 64. Unit 62 processes (i.e. parses,  
collates and assembles) program specific information including  
25 program guide and system information and controller 64 performs  
the remaining control functions required in operating decoder  
100. Although the functions of unit 60 may be implemented as  
separate elements 62 and 64 as depicted in Figure 1, they may  
alternatively be implemented within a single processor. For  
30 example, the functions of units 62 and 64 may be incorporated  
within the programmed instructions of a microprocessor.  
Processor 60 configures processor 13, demodulator 15, decoder 17  
and decoder system 100 to demodulate and decode the input  
signal format and coding type. Units 13, 15, 17 and sub-units  
35 within decoder 100 are individually configured for the input  
signal type by processor 60 setting control register values within  
these elements using a bi-directional data and control signal bus C.

The transport stream provided to decoder 100  
comprises data packets containing program channel data and  
40 program specific information. Unit 22 directs the program specific  
information packets to processor 60 which parses, collates and

5 assembles this information into hierarchically arranged tables. Individual data packets comprising the User selected program channel are identified and assembled using the assembled program specific information. The program specific information contains conditional access, network information and identification  
10 and linking data enabling the system of Figure 1 to tune to a desired channel and assemble data packets to form complete programs. The program specific information also contains ancillary program guide information (e.g. an Electronic Program Guide - EPG) and descriptive text related to the broadcast programs as  
15 well as data supporting the identification and assembly of this ancillary information.

The program specific information is assembled by processor 60 into multiple hierarchically arranged and inter-linked tables. An exemplary hierarchical table arrangement  
20 includes a Master Guide Table (MGT), a Channel Information Table (CIT), Event Information Tables (EITs) and optional tables such as Extended Text Tables (ETTs). The MGT contains information for acquiring program specific information conveyed in other tables such as identifiers for identifying data packets associated with the  
25 other tables. The CIT contains information for tuning and navigation to receive a User selected program channel. The EIT contains descriptive lists of programs (events) receivable on the channels listed in the CIT. The ETT contains text messages describing programs and program channels. Additional program  
30 specific information describing and supplementing items within the hierarchical tables is conveyed within descriptor information elements. The program specific information acquired by processor 60 via unit 22 is stored within internal memory of unit 60.

Considering Figure 1 in detail, a carrier modulated  
35 with signals carrying program representative audio, video and associated data received by antenna 10, is converted to digital form and processed by input processor 13. Processor 13 includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input signal to a  
40 lower frequency band suitable for further processing. In this exemplary system, the input signal received by antenna 10



5 contains 33 Physical Transmission Channels (PTCs 0-32). Each Physical Transmission Channel (PTC) is allocated a 6 MHz bandwidth and contains, for example, up to 6 sub-channels.

10 It is assumed for exemplary purposes that a video receiver user selects a sub-channel (SC) for viewing using remote control unit 70. Processor 60 uses the selection information provided from remote control unit 70 via interface 65 to appropriately configure the elements of decoder 100 to receive the PTC corresponding to the selected sub-channel SC. Following  
15 down conversion, the output signal from unit 13 for the selected PTC has a bandwidth of 6 MHz and a center frequency in the range of 119-405 MHz. In the following discussion, an RF channel or Physical Transmission Channel (PTC) refers to an allocated broadcaster transmission channel band which encompasses one or more sub-channels (also termed virtual or logical channels).

20 Processor 60 configures the radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages of unit 13 to receive the selected PTC. The down-converted frequency output for the selected PTC is demodulated by unit 15. The primary functions of demodulator 15 are recovery and  
25 tracking of the carrier frequency, recovery of the transmitted data clock frequency, and recovery of the video data itself. Unit 15 also recovers sampling and synchronization clocks that correspond to transmitter clocks and are used for timing the operation of processor 13, demodulator 15 and decoder 17. The recovered  
30 output from unit 15 is provided to decoder 17.

The output from demodulator 15 is mapped into byte length data segments, deinterleaved and Reed-Solomon error corrected according to known principles by unit 17. In addition, unit 17 provides a Forward Error Correction (FEC) validity or lock  
35 indication to processor 60. Reed-Solomon error correction is a known type of Forward Error Correction. The FEC lock indication signals that the Reed-Solomon error correction is synchronized to the data being corrected and is providing a valid output. It is to be noted that the demodulator and decoder functions implemented  
40 by units 13, 15 and 17 are individually known and generally described, for example, in the reference text *Digital*

- 5     *Communication*, Lee and Messerschmidt (Kluwer Academic Press, Boston, MA, USA, 1988).

          The corrected output data from unit 17 is processed by MPEG compatible transport processor and demultiplexer 22. The individual packets that comprise either particular program  
10    channel content, or program specific information, are identified by their Packet Identifiers (PIDs). Processor 22 separates data according to type based on an analysis of Packet Identifiers (PIDs) contained within packet header information and provides  
15    synchronization and error indication information used in subsequent video, audio and data decompression.

          The corrected output data provided to processor 22 is in the form of a transport datastream containing program channel content and program specific information for many programs distributed through several sub-channels. The program specific  
20    information in this exemplary description describes sub-channels present in a transport stream of a particular PTC. However, in another embodiment the program specific information may also describe sub-channels located in other PTCs and conveyed in different transport streams. Groups of these sub-channels may be  
25    associated in that their source is a particular broadcaster or they occupy the transmission bandwidth previously allocated to an analog NTSC compatible broadcast channel. Further, individual packets that comprise a selected program channel in the transport stream are identified and assembled by processor 60 operating in  
30    conjunction with processor 22 using PIDs contained in the program specific information.

          The program specific information is in the form of hierarchically arranged tables including an MGT, CIT, EIT, and ETT together with supplementary descriptor information. The PID that  
35    identifies packets comprising the MGT data is predetermined and stored within processor 60 internal memory. Further, the MGT conveys the PIDs that identify the CIT, EIT, and ETT data and conveys other information indicating the size of these tables. Processor 60 monitors the MGT for updates to identify any  
40    changes in PIDs or table sizes. Therefore, after processor 60 determines from the FEC lock indication provided by unit 17 that

5 valid data is being provided to transport processor 22, the MGT  
may be acquired without additional PID information. Using Control  
signal C, processor 60 configures transport processor 22 to select  
the data packets comprising the remaining program specific  
information including the CIT, EIT and ETT data. Processor 22  
10 matches the PIDs of incoming packets provided by unit 17 with  
PID values pre-loaded in control registers within unit 22 by  
processor 60. Further, processor 60 accesses, parses and assembles  
the program specific information packets captured by processor  
22 and stores the program specific information within its internal  
15 memory. Processor 60 derives tuning parameters including PTC  
carrier frequency, demodulation characteristics, and sub-channel  
PIDs, from the acquired program specific information. Processor  
60 uses this information in configuring units 13, 15, 17 and  
decoder 100 elements to acquire selected sub-channel (SC)  
20 program content.

The program specific information including MGT, CIT,  
EIT, and ETT data and associated descriptors acquired and collated  
by processor 60 incorporates advantageous features exemplified  
in the data formats presented in Figures 2-9. These features  
25 facilitate the identification, acquisition, assembly and decoding of  
program channel content and associated program guide data by  
decoder 100 (Figure 1). Processor 60 forms a MGT as exemplified  
by the data format of Figure 2 by accessing and assembling the  
program specific information packets that are stored in the unit  
30 60 internal memory. The MGT contains data identifiers e.g.  
PID\_ETT 205 and PID\_PG 210 (Figure 2) enabling the assembly of  
the CIT, EIT and ETT tables. Processor 60 uses the MGT data  
identifiers to access and assemble the program specific  
information packets to form the CIT, EIT, and ETT data and  
35 associated descriptors.

Processor 60 uses the acquired CIT channel map  
information, as exemplified in Figure 3, to identify the packets  
comprising the sub-channel SC that the User selected to view. A  
user selects sub-channel SC for viewing by entering two program  
40 channel numbers via remote control unit 70 and interface 65.  
Individual program channels are advantageously allocated both a

5 first and a second identification number. The first identification number (a major number as indicated by bundle\_number 300 in Figure 3) identifies the broadcast source and broadcaster channel brand number e.g. Fox 5™, Channel 13™. The first identification number indicates a broadcast source of a program or service and  
10 may be independent of the RF channel on which the program is broadcast. However, in other embodiments the first identification number may be associated with a broadcast RF channel or be associated with other program characteristics such as a program category or theme e.g. movies. The second identification number  
15 (a minor number as indicated by channel\_number\_in\_bundle 305 in Figure 3) identifies a sub-channel corresponding to a specific service within a group of services provided by a broadcaster. The first and second identification numbers in conjunction identify a particular service as a sub-channel provided by a specific  
20 broadcaster. Although, the selected sub-channel SC may occupy an RF bandwidth within an encompassing channel spectrum associated with the broadcast source, neither the first or second identification numbers are associated with such a spectrum. However, this association may be made in an alternative  
25 embodiment. This dual numbering system enables a broadcaster to retain channel brand identity across a range of dynamically allocable broadcast sub-channels.

The dual program channel identification numbers used to select sub-channel SC may be entered by the user in a variety  
30 of ways. These may include using remote unit 70 to select sub-channel SC from within a hierarchical menu system displaying program channel selections in a program guide or by simple sequential number entry via the unit 70 keypad, for example. The channel selection system may also encompass the use of a  
35 different data entry device such as a keyboard or discrete switches, for example. Further, the data entry system also accommodates the entry of a single channel identification number as well as dual identification numbers. Upon detecting a channel selection completion command, processor 60 converts a single  
40 channel identification number entry into dual identification numbers. Processor 60 converts the single channel identification

5 number to dual channel identification numbers in accordance with a predetermined conversion map. This conversion may also be performed using a predetermined and stored algorithm or formula. The derived dual identification numbers are used by processor 60 for packet identification, tuning and for identifying  
10 other decoder information in the manner previously described as if both numbers had been entered by a user.

Processor 60 uses the received program channel identification numbers 300 and 305 provided from remote control unit 70 via interface 65 to determine the PTC corresponding to the  
15 selected sub-channel SC from the CIT. Once the PTC number (item 315 in Figure 3) is determined, processor 60 (Figure 1) configures units 13, 15, and 17 to receive the PTC for the selected sub-channel SC. The unique program sub-channel determined from the program channel identification numbers 300 and 305 may  
20 alternatively be termed a service or a virtual channel or a logical channel and the CIT may be deemed a virtual channel table. Further, as well as associating a particular PTC with first and second sub-channel identification numbers 300 and 305 of selected sub-channel SC, the CIT also associates other parameters  
25 with SC. These parameters include (a) a channel\_id 320 for linking the selected sub-channel SC with program content information conveyed in the EITs, (b) a channel\_type indicator 325 identifying whether the sub-channel data is, analog e.g. NTSC, digital video e.g. ATSC video or digital audio e.g. ATSC audio, (c) an ETM\_flag 330  
30 indicating whether a text message is available for this sub-channel, (d) a channel name 340 and (e) a descriptor 335 e.g. a Service Location Descriptor as described later.

Processor 60 advantageously determines program map information for the selected sub-channel SC from Service Location  
35 Descriptor (SLD) conveyed within the CIT. The SLD program map information is exemplified by the data format of Figure 4. The SLD associates the selected sub-channel SC with packet identifiers, e.g. item 420, used to identify individual packetized datastreams that constitute the components of a program being transmitted on  
40 selected sub-channel SC. In addition, the SLD program map information, in conjunction with the CIT, maps the selected sub-

5 channel SC to a program number 405, a PCR (Program Clock Reference) identifier 410, a language code indicator 425, and a stream type identifier 415 identifying a stream as video, audio, control, auxiliary or private information, for example.

10 The SLD program map information replicates information already present within the Program Map Table (PMT) segment of the MPEG compatible transport stream input to decoder 100. However, by incorporating the SLD within the CIT, the time required by decoder 100 to identify and acquire a program being transmitted on selected sub-channel SC is  
15 advantageously reduced. This is because the CIT and SLD provide formatted and linked information sufficient to enable processor 60 to directly configure and tune the system of Figure 1 to receive the selected sub-channel SC. Specifically, the CIT and SLD directly associate individual first and second sub-channel identification  
20 numbers with the PIDs for identifying the datastreams that constitute a program being conveyed on this sub-channel. This enables processor 60 to configure the system of Figure 1 to receive the selected sub-channel SC without acquiring and using the Program Map Table (PMT) information in the MPEG  
25 compatible transport stream input to decoder 100. In addition, the data partitioning, data formatting and data repetition frequency characteristics of the CIT and SLD program map information may be determined independently of the requirements of MPEG PMT information.

30 The packetized decoded transport stream input to decoder 100 from unit 17 contains video, audio and data representing TV programs, for example, and also contains sub-picture data. The sub-picture data contains picture elements associated with programs and channels selectable by a user for  
35 viewing including program guides, display commands, subtitling, selectable menu options or other items, for example. As such, the sub-picture data includes the EIT containing descriptive lists of programs (events) receivable on the sub-channels listed in the CIT and also contains the ETT containing text messages describing  
40 programs and program sub-channels.

5 Processor 60 determines from the CIT and SLD the  
PIDs of the video, audio and sub-picture streams constituting the  
program being transmitted on selected sub-channel SC. Processor  
22, matches the PIDs of incoming packets provided by decoder 17  
with PID values of the video, audio and sub-picture streams being  
10 transmitted on sub-channel SC. These PID values are pre-loaded in  
control registers within unit 22 by processor 60. In this manner,  
processor 22 captures packets constituting the program  
transmitted on sub-channel SC and forms them into MPEG  
compatible video, audio and sub-picture streams for output to  
15 video decoder 25, audio decoder 35 and sub-picture processor 30  
respectively. The video and audio streams contain compressed  
video and audio data representing the selected sub-channel SC  
program content. The sub-picture data contains the EIT and ETT  
information associated with the sub-channel SC program content.

20 Decoder 25 decodes and decompresses the MPEG  
compatible packetized video data from unit 22 and provides  
decompressed program representative pixel data to NTSC encoder  
45 via multiplexer 40. Similarly, audio processor 35 decodes the  
packetized audio data from unit 22 and provides decoded and  
25 amplified audio data, synchronized with the associated  
decompressed video data, to device 55 for audio reproduction.  
Processor 30 decodes and decompresses sub-picture data received  
from unit 22.

The sub-picture data decoded by processor 30 includes  
30 text messages (Extended Text Messages - ETMs) in an ETT in the  
exemplary data format presented in Figure 5. The text messages  
conveyed in the ETT of Figure 5 are advantageously partitioned  
into time periods of specified duration. The segmented text  
messages describe programs occurring in a period of specified  
35 duration and start time e.g. 3 hour blocks starting from 12 a.m., 3  
p.m., 6 p.m.... etc. Indicators defining the duration and start time  
applicable to the conveyed text messages are included in the MGT  
of Figure 2 (duration item 215 and application\_time item 220 of  
Figure 2 respectively). A text message (e.g.  
40 extended\_text\_message 505) is conveyed together with a text  
message identifier (ETM\_id 510) in the format of Figure 5.

5 Decoder 100 (Figure 1) is able to more efficiently acquire, process and store program descriptive text messages that are partitioned into time periods of specified duration than is possible in the absence of such segmentation. This is because segmented text messages exclude information occurring outside  
10 the specified time period and consequently are smaller than non-segmented text messages. Therefore, segmented text message data occupies less storage space and can be acquired and processed more quickly than larger data blocks of non-segmented data. Further, the data format of Figure 5 allows a user to acquire text  
15 message data for a selected sub-channel SC or a group of selected program sub-channels. This allows the identification, acquisition and decoding of text message data by decoder 100 to be focused on the programs and sub-channels of interest to a user and reduces the acquisition of redundant text message information.

20 A text message conveyed in an ETT may contain channel information or program (event) information. Figure 6 shows an exemplary format for assigning a text message identifier ETM\_id 510 of Figure 5 that identifies the type of text message e.g. whether the text message contains channel information (item  
25 610 of Figure 6) or program information (item 605 of Figure 6). The text message identifier 510 (Figure 5) also identifies the source e.g. sub-channel to which the text message pertains.

A text message 505 conveyed in the ETT of Figure 5 is compressed and formatted according to the multiple compressed  
30 text string format of Figure 7. The compressed text string format advantageously incorporates indicators facilitating the identification and decoding of multiple compressed text strings by processor 30 in decoder 100 of Figure 1. Processor 30 decodes text  
string 505 (Figure 5) received from unit 22 (Figure 1) by  
35 determining the compression, coding and language characteristics of the text string from indicators 705, 710 and 715 (Figure 7) respectively. Specifically, processor 30, operating in conjunction with processor 60, decompresses received text string 505 by applying a decompression function e.g. a Huffman decompression  
40 function, selected using indicator 705. Similarly, processor 30, decodes the received text string by applying a decoding function



5 interpreting text characters according to a character code set selected using indicator 710 and a language code set selected using indicator 715. Further, processor 30 determines the number of text strings to be processed and the number of bytes in each text string from indicators 725 and 720 respectively.

10 Figure 8 shows an exemplary indicator definition for compression indicator 705 within the multiple compressed text string format of Figure 7. It is to be noted that compression indicator 705 may indicate that no compression function is employed within a text string. In this case, processor 30 does not  
15 apply a decompression function to the text string received from unit 22. Figure 9 shows an exemplary indicator definition for coding indicator 710 within the multiple compressed text string format of Figure 7.

Processor 30 assembles and formats the decoded and  
20 decompressed text string elements of text string 505 (Figure 5) to form a decoded text string for output to On-Screen Display (OSD) and graphics generator 37 (Figure 1). Unit 37 interprets and formats the text string character data from unit 30 and generates formatted pixel mapped text and graphics for presentation on unit  
25 50. The formatted pixel mapped text and graphics data may represent a program guide or other type of menu or user interface for subsequent display on unit 50. Unit 37 also processes EIT, ETT and other information to generate pixel mapped data representing, subtitling, control and information menu displays  
30 including selectable menu options, and other items, for presentation on unit 50. The control and information displays enable function selection and entry of device operating parameters for User operation of decoder 100.

The text and graphics produced by OSD generator 37  
35 are generated in the form of overlay pixel map data under direction of processor 60. The overlay pixel map data from unit 37 is combined and synchronized with the decompressed pixel representative data from MPEG decoder 25 in encoder 45 via multiplexer 40 under direction of processor 60. Combined pixel  
40 map data representing a video program on sub-channel SC

5 together with associated sub-picture text message data is encoded by NTSC encoder 45 and output to device 50 for display.

In a storage mode of the system of Figure 1, the corrected output data from unit 17 is processed by decoder 100 to provide an MPEG compatible datastream for storage. In this mode,  
10 a program is selected for storage by a user via remote unit 70 and interface 65. Processor 22, in conjunction with processor 60 forms condensed program specific information including MGT, CIT, EIT and ETT data and descriptors containing the advantageous features previously described. The condensed program specific  
15 information supports decoding of the program selected for storage but excludes unrelated information. Processor 60, in conjunction with processor 22 forms a composite MPEG compatible datastream containing packetized content data of the selected program and associated condensed program specific information. The composite  
20 datastream is output to storage interface 95.

Storage interface 95 buffers the composite datastream to reduce gaps and bit rate variation in the data. The resultant buffered data is processed by storage device 90 to be suitable for storage on medium 105. Storage device 90 encodes the buffered  
25 datastream from interface 95 using known error encoding techniques such as channel coding, interleaving and Reed Solomon encoding to produce an encoded datastream suitable for storage. Unit 90 stores the resultant encoded datastream incorporating the condensed program specific information on medium 105.

30 Figure 10 shows a method for generating program specific information including MGT, CIT, EIT and ETT data and descriptors containing the advantageous features previously described. The method may be employed at an encoder for broadcasting video data such as the data received by antenna 10  
35 of Figure 1 or the method may be employed within a decoder unit such as within processor 60 of Figure 1.

Following the start at step 800 of Figure 10, a CIT is generated in step 810. The CIT contains sub-channel and program identification information enabling acquisition of available  
40 broadcast programs and sub-channels. The CIT incorporates first and second sub-channel identification numbers and an SLD

5 containing packet identifiers for identifying individual packetized  
datastreams that constitute individual programs to be transmitted  
on particular sub-channels. The generated CIT also incorporates  
items linked to listed program sub-channels including a program  
number, a PCR (Program Clock Reference) identifier, a language  
10 code indicator, and a stream type identifier, as previously  
described in connection with Figure 1.

In step 815, an EIT is generated containing program  
guide information including descriptive lists of programs (events)  
receivable on the sub-channels listed in the CIT. In step 820, an  
15 ETT is generated containing text messages describing programs,  
for example. Each text message is partitioned into time periods of  
specified duration. The duration and application time of the  
segmented text message data is also defined by indicators in the  
ETT itself. The text message data is encoded and compressed  
20 according to known techniques and conveyed in the ETT along  
with indicators defining the compression, coding and language  
characteristics employed. The ETT is also generated to include  
indicators defining the number of text strings to be processed and  
the number of bytes in each text string. In step 822 an MGT is  
25 generated containing data identifiers enabling the identification  
and assembly of CIT, EIT and ETT information. The MGT also  
conveys table size information for the previously generated CIT,  
EIT and ETT.

In step 825, program specific information is formed  
30 including the MGT, CIT, EIT and ETT data and descriptors  
generated in steps 805-822. In step 830, the program specific  
information together with video and audio program  
representative components for multiple sub-channels is formatted  
into a transport stream for output. In step 835, the output  
35 transport stream is further processed to be suitable for  
transmission to another device such as a receiver, video server, or  
storage device for recording on a storage medium, for example.  
The processes performed in step 835 include known encoding  
functions such as data compression Reed-Solomon encoding,  
40 interleaving, scrambling, trellis encoding, and carrier modulation.  
The process is complete and terminates at step 840. In the process

5 of Figure 10, multiple CIT, EIT and ETT tables may be formed and incorporated in the program specific information in order to accommodate expanded numbers of sub-channels.

The architecture of Figure 1 is not exclusive. Other architectures may be derived in accordance with the principles of the invention to accomplish the same objectives. Further, the functions of the elements of decoder 100 of Figure 1 and the process steps of Figure 10 may be implemented in whole or in part within the programmed instructions of a microprocessor. In addition, the principles of the invention apply to any form of MPEG or non-MPEG compatible electronic program guide. A datastream formed according to the invention principles may be used in a variety of applications including video server or PC type communication via telephone lines, for example. A program datastream with one or more components of video, audio and data formed to incorporate program specific information according to invention principles may be recorded on a storage medium and transmitted or re-broadcast to other servers, PCs or receivers. Further, any reference herein to "bandwidth" is to be interpreted expansively to include bit rate capacity and is not limited to a frequency spectrum, for example.

5

CLAIMS:

10

1. Apparatus for decoding a datastream of MPEG compatible packetized program information containing program map table information to provide decoded program data, comprising:

15

means for identifying (60,22) channel map information conveyed within said packetized program information, said channel map information associating a broadcast channel (300,305) with packet identifiers (420) used to identify individual packetized datastreams that constitute a program transmitted in said broadcast channel; and

20

means for assembling (60,22) said identified information to form a channel map for identifying said individual packetized datastreams constituting said program, wherein

said channel map information replicates information conveyed in said MPEG compatible program map table information.

25

2. Apparatus according to claim 1, wherein said channel map information further associates an individual program with a corresponding physical transmission channel carrier frequency (315).

30

3. Apparatus according to claim 1, including means for tuning (13,15,17) to receive said program transmitted on said broadcast channel using said channel map information for acquisition of said program.

5                   4. Apparatus for decoding MPEG compatible packetized program information to provide decoded program data, comprising:

                  means for identifying (60,22) channel map information conveyed within said packetized program information, said  
10 channel map information associating a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted in said broadcast channel; and

                  means for assembling (60,22) said identified  
15 information to form a channel map for identifying said individual packetized datastreams constituting said program, wherein

                  said channel map information associates an individual program (420) with a corresponding language type indicator (425).

20

                  5. A storage medium containing MPEG compatible digital data representing video information comprising:

                  a video program;

                  MPEG compatible program map table information  
25 (405-420) ; and

                  channel map information contained within said MPEG compatible digital data, said channel map information associating packet identifiers (420) with individual packetized datastreams that constitute said video program, wherein

30                   said channel map information replicates information (410,420) conveyed in said MPEG compatible program map table information.

5           6. Apparatus for forming program guide information suitable for decoding MPEG compatible packetized program information containing program map table information to provide decoded program data, comprising:

10               means for forming (60,22) channel map information including information associating a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted in said broadcast channel; and

15               means for incorporating (60,22) said channel map information into packetized program guide information for output, wherein

                  said channel map information replicates information (410,420) conveyed in said MPEG compatible program map table information.

20           7. Apparatus according to claim 1 or 4 or 5 or 6, wherein

                  said channel map information further associates an individual program with a corresponding program clock reference (PCR) value (410).

25           8. Apparatus according to claim 1 or 5 or 6, wherein said channel map information further associates an individual program with a corresponding language type indicator (425).

30           9. Apparatus according to claim 1 or 6, wherein said channel map information further associates said packet identifiers (420) with first and second identification numbers (300,305) used in conjunction to identify said broadcast  
35   channel.

- 5                   10. Apparatus according to claim 1 or 6, wherein  
said information associating said broadcast channel  
with said packet identifiers is conveyed within a descriptor  
section (335) of said channel map information.
- 10                   11. Apparatus according to claim 10, wherein  
said channel map information associates a plurality of  
broadcast channels (315,320,325) with corresponding descriptor  
sections (335).
- 15                   12. Apparatus according to claim 1 or 6, wherein  
said channel map information further associates a  
datastream type indicator with an individual packetized  
datastream, said datastream type indicator (415) identifying  
whether said individual packetized datastream contains at least  
20 one of a) audio information, and b) video information.
13. A method for decoding MPEG compatible  
packetized program information containing program map table  
information to provide decoded program data, comprising the  
25 steps of:  
                  identifying channel map information (60,22) conveyed  
within said packetized program information, said channel map  
information associating a broadcast channel with packet  
identifiers used to identify individual packetized datastreams that  
30 constitute a program transmitted on said broadcast channel; and  
                  assembling said identified information (60,22) to form  
a channel map suitable for use in identifying said individual  
packetized datastreams constituting said program, wherein  
                  said channel map information replicates  
35 information (410,420) conveyed in said MPEG compatible program  
map table information.



5           14. A method for forming program guide information suitable for decoding MPEG compatible packetized program information containing program map table information to provide decoded program data, comprising the steps of:

                  forming channel map information (60,22) including  
10   information associating a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted on said broadcast channel; and  
                  incorporating said channel map information (60,22)  
                  into packetized program guide information for output, wherein  
15                said channel map information replicates information (410,420) conveyed in said MPEG compatible program map table information.



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## Bit Stream Syntax for the Master Guide Table

Syntax	Bits	Format
master_guide_table_section () {		
table_id	8	0xE0
section_syntax_indicator	1	'1'
private_indicator	1	'1'
reserved	2	'11'
private_section_length	12	uimsbf
table_id_extension	16	0x0000
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	'1'
section_number	8	0x00
last_section_number	8	0x00
reserved	3	'111'
CRT_version_number	5	uimsbf
zero	4	'0000'
num_pg	4	uimsbf
220   for (i=0; i< num_pg; i++) PG(i) {		
application_time	40	uimsbf
duration	16	uimsbf
reserved	2	'11'
215    CT_flag	1	blsbf
num_bytes	21	uimsbf
210    reserved	3	'111'
PID_PG [i]	13	uimsbf
reserved	3	'111'
PID_ETT [i]	13	uimsbf
205    reserved	4	uimsbf
PG_descriptors_length	12	uimsbf
for(j = 0; j< M; j++)		
descriptor ()	var	
}		
reserved	4	uimsbf
descriptors_length	12	uimsbf
for (i = 0; i< N; i++)		
descriptor ()	var	
CRC_32	32	rpchof
}		

FIGURE 2

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## Bit Stream Syntax for the Channel Information Table

Syntax	Bits	Format
channel_guide_table_section () {		
table_id	8	0xE3
section_syntax_indicator	1	'1'
private_indicator	1	'1'
reserved	2	'11'
section_length	12	uimsbf
table_id_extension	16	uimsbf
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	'1'
section_number	8	uimsbf
last_section_number	8	uimsbf
num_channels_in_section	8	uimsbf
for (k=0; k<num_channels_in_section;k ++){		
short_name	8*6	ISO-639
channel_visibility	32	bslbf
bundle_channel_number{		
bundle_number	12	uimsbf
channel_number_in_bundle	12	uimsbf
}		
Channel_PTC	8	uimsbf
channel_id	16	uimsbf
channel_type	8	uimsbf
reserved	3	'111'
ETM_flag	1	bslbf
descriptors_length	12	uimsbf
for (i=0;i<N;i++){		
descriptors()		
}		
}		
CRC_32	32	rpchof
}		

FIGURE 3

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## Bit Stream Syntax for the Service Location Descriptor

Syntax	Bits	Format
service_location_descriptor () {		
405     descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
program_number	16	uimsbf
410     reserved	3	'111'
PCR_PID	13	uimsbf
number_PIDs	8	uimsbf
415     for (i=1;i<number_PIDs;i++){		
stream_type	8	uimsbf
420         reserved	3	bslbf
elementary_PID	13	uimsbf
ISO_639_language_code	8*3	uimsbf
425     }		
}		

FIGURE 4

57

Bit Stream Syntax for the Extended Text Table

Syntax	Bits	Format
extended_text_table_section () {		
table_id	8	0xE5
section_syntax_indicator	1	'0'
private_indicator	1	'1'
reserved	2	'11'
private_section_length	12	uimsbf
ETM_id	32	bsbf
extended_text_message ()	var	
}		

FIGURE 5

Bit	1	2	3	18	19	32
channel ETM_id	0	0	channel_id	111	_____	111
event ETM_id	1	0	channel_id	_____	_____	event_id

FIGURE 6

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## Bit Stream Syntax for multiple compressed strings

Syntax	Bits	Format
multiple_compressed_strings () {		
725     number_strings	8	uimbsf
720     for (i = 0; i < number_strings; i++) {		
715         number_bytes	16	uimbsf
710         ISO_639_language_code	8*3	uimbsf
705         coding_indicator	8	bslbf
compression_type	8	uimbsf
for (j = 0; j < number_bytes; j++)		
compressed_string_byte [j]	8	uimbsf
}		
}		

FIGURE 7

compression_type	compression method
0x00	No compression
0x01	Huffman coding based on the default Huffman table
0x02	LZW
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

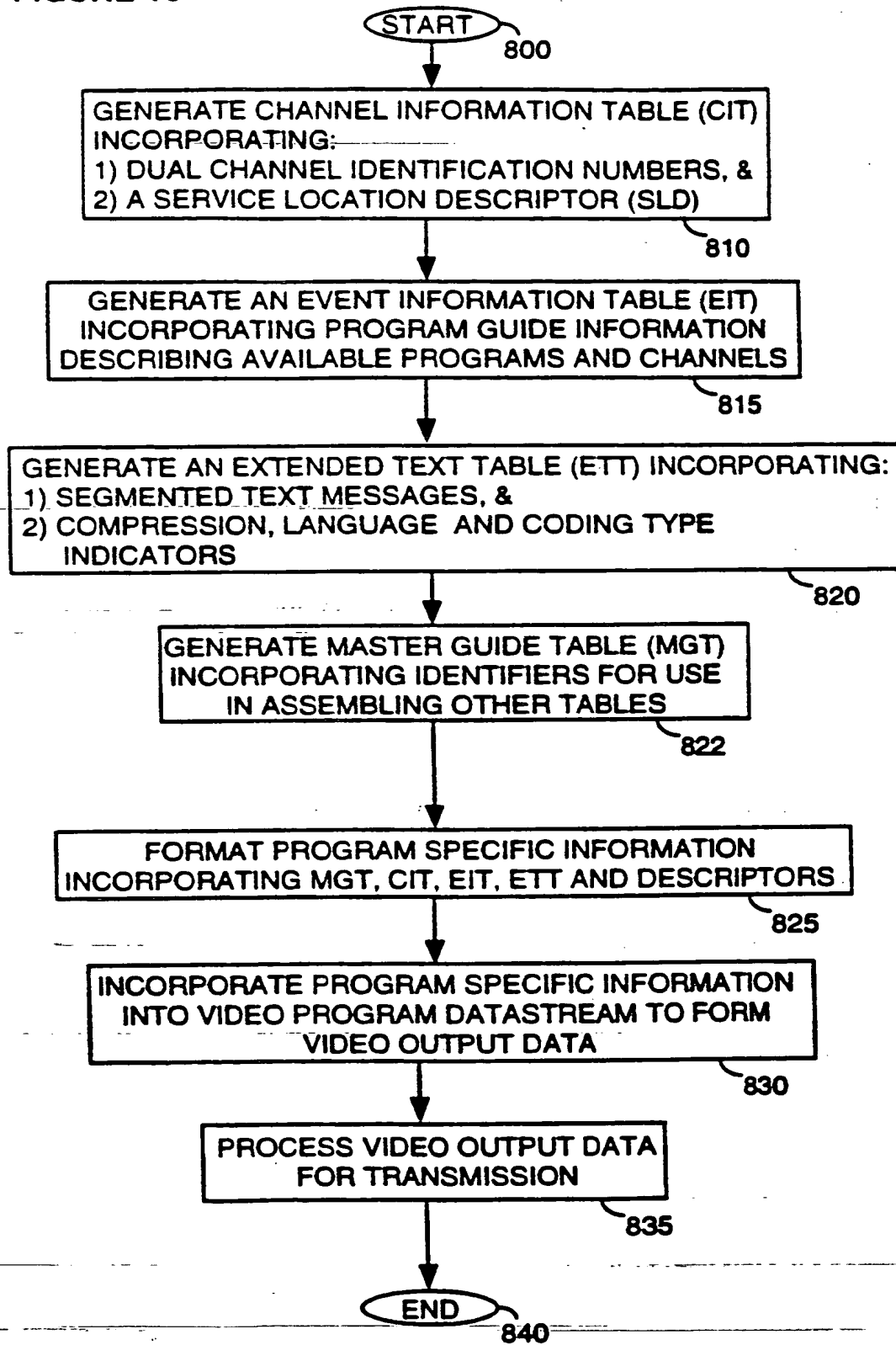
FIGURE 8

coding_indicator	coding method
0x00	Unicode
0x01	Latin-1
0x02	Latin-2
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 9

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FIGURE 10





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/13516

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04N5/44

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EUROPEAN BROADCASTING UNION: "digital broadcasting systems for television, sound and data services; specification for service information (SI) in digital broadcasting (DVB) systems" October 1995, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, SOPHIA ANTIPOLIS (FR) XP002079535 see page 10-14 see page 45; tables 40-42	1,4-6, 13,14
A	US 5 600 378 A (WASILEWSKI ANTHONY J) 4 February 1997 see abstract	1,4-6, 13,14
A	US 5 594 492 A (LEW EUGENE L ET AL) 14 January 1997	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex

### \* Special categories of cited documents:

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# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

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